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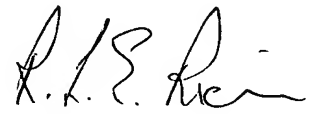
DECLARATION

I, Robin L. E. Rich, M.A., of the above address, do hereby solemnly and sincerely declare that I am conversant with the German and English languages and am a competent translator thereof and that, to the best of my knowledge and belief, the attached document in the English language is a true and correct translation of the attached text of German Patent Application No. 102 31 737.2 "Edelmetallfreie Dentalguss-Legierung".

Signed this twenty-first day of July, 2003



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Nonprecious dental casting alloy

The invention relates to a nonprecious dental casting alloy.

Alloys to be used in dentistry must satisfy special general requirements. For example, burning-on alloys for powder metallurgy must be compatible with commercial dental ceramics as regards thermal expansion and contraction.

In addition, these alloys must be capable of forming a thin oxide layer guaranteeing adhesion between metallic and ceramic surfaces.

In addition, the color of the oxide may not show through the opaque porcelain for esthetic reasons.

In the case of dental castings that are not to be veneered, *eg*, removable prostheses with clips, a certain activation capacity and resilient hardness are required. Another particularly important factor in dentistry is that processing of the alloys used should be possible in the dental laboratory using available means, *ie* they should be capable of being cast with conventional casting centrifuges. Furthermore, those dental casting alloys are to be preferred whose hardness in the cast state does not deviate to an extensive degree from the hardness of natural dental enamel so that no appreciable abrasive wear of the tooth is caused by contact of the dental casting alloy with the surface of the tooth.. Furthermore, it is advantageous when the alloy can be produced with a low nickel content so that patients who are allergic to nickel can also be provided with such prostheses.

Co/Cr-based casting alloys have been used for so-called prosthetic model casts since 1935. As from *ca* 1980, such alloys based on cobalt-chromium have also been developed into alloys for crown and bridge frameworks which can be provided with a tooth-colored veneer of ceramic material. In order to adapt model casting alloys to the requirements of ceramic veneering, a usual metallurgical measure has been to remove carbon from these alloys, since the use of frameworks firmly cemented in the mouth does not call for such a high degree of hardness of the model casting alloys, which would, rather, impede den-

tal processing. For example, DE 36 09 184 C2 mentions in this context a maximum carbon content of 0.05 wt%.

Alloys used in model casting work must, on the other hand, satisfy greater demands of hardness and tensile strength, particularly flexural strength. Special binding agents have already been proposed in this context, by means of which specific and conventional model casting alloys can be ceramically veneered despite the high coefficients of thermal expansion, but the carbon present in the conventional model casting alloys in a concentration of up to 0.6 % causes coarsening of the carbides during firing and thus leads to deterioration of the mechanical properties.

Such binding agents are, further, not resistant to corrosion.

Common model casting alloys exhibit, unlike veneerable alloys for crowns and bridges, a coefficient of thermal expansion of from 15.5 to 16 $\cdot$ 10^{-6} K^{-1} and are thus not suitable for a porcelain veneer (*cf*, *eg*, Siebert, Dentallegierungen in der zahnärtzlichen Prothetik, C. Hanser Verlag 1989, page 38). Due to the fact that the thermal expansion properties of the metal and porcelain do not match, stresses occur which find relaxation in spalling or retarded spalling.

It is an object of the present invention to provide an alloy which can be used for making crown and bridge frameworks that can be provided with a tooth-colored ceramic veneer, on the one hand, and which can be used for making model casting bases, on the other hand.

According to the invention, this object is achieved by a nonprecious dental casting alloy, substantially comprising:

25 – 35	wt%	Cr
2 – 6	wt%	Mo
3 – 12	wt%	W
0.8 – 1.5	wt%	Si
up to 0.3	wt%	Mn

0.1 – 0.35	wt%	N
<0.1	wt%	Ni
0.2 – 1.5	wt%	Ta

and manufacturing impurities of <0,1 wt% in each case,
remainder cobalt,
the content of tungsten being always greater than the content of molybdenum.

The alloy of the invention is an alloy which can be used both for making crown and bridge frameworks that can be veneered with odontoceramic materials, and for making model casting bases.

In particular, the alloy of the invention can be produced without the inclusion of carbon. To this end, the content of C should be <0.05 wt%. The result is that the alloy of the present invention also shows very good laser-weldability.

Freedom from carbon may be easily realized without detriment to the mechanical properties of the present alloy when used for both purposes, *ie* for making ceramic-veneerable basic constructions and for the production of model casts, *ie* basic constructions for removable dentures containing nonveneered metal components such as retentive clasps.

Dental alloys free from carbon have been described (*cf* DE 198 45 638) which are suitable for use as materials for dental prosthetics, particularly for the production of suprastructures. But parts made from these alloys are not suitable for ceramic veneering, as is readily noticeable to the person skilled in the art .

Another alloy is disclosed in DE 41 23 606 C2 which is likewise suitable for the production of castings for crowns, bridges, and models is. The coefficient of thermal expansion stated in said reference shows that this alloy is suitable for ceramic veneers. However, it differs from the alloy of the invention and must, in particular, contain rare-earth elements to an extent of from 0.15 to 0.35 wt%, which is a disadvantage in a different as-

pect of the present invention, namely the desire to be able to produce this alloy by extrusion.

It is known to the person skilled in the art that alloys having a content of rare earth metals cannot be produced by extrusion since the lanthanoid elements do no guarantee consistent analysis results due to their fusion loss characteristics. When production is effected by extrusion casting, however, the process involves keeping the metal alloy in the liquid state for a number of hours up to half a day, so that the fusion losses of the alloying elements are considerable.

The present alloy can now be produced free from rare-earth elements, *ie* it requires no content of rare earth metals to enable adjustment of desirable mechanical and other properties.

The low modulus of elasticity of the alloys according to DE 41 23 606 C2 furthermore shows that these are not suitable for the synthesis of clasp dental prostheses, as is the alloy of the invention.

The production of the alloys by extrusion casting has the great advantage that the resultant products are cylindrical and can thus be subsequently processed at low cost.

The invention finally relates to the use of the alloy of the invention, as described above, for the production of prosthetic constructions to be veneered with tooth-colored ceramic materials.

Another aspect of the present invention relates to the use of the alloy described above for the production of model casting bases.

Finally, the invention relates, according to another aspect, to a process for the production of a dental casting alloy which is free from nonprecious metals and can be produced by extrusion casting methods.

An exemplary alloy has the following composition:

Co	58.5	wt%
Cr	30.7	wt%
Mo	3.1	wt%
W	5.0	wt%
Mn	0.03	wt%
Si	1.3	wt%
N	0.2	wt%
Ta	1	wt%

It is important for the alloy of the invention to have a content of tungsten which is always greater than the content of molybdenum.

The mechanical properties found on the alloy of the invention according to above example are summarized in the following table:

Tensile stress at a given elongation R_P 0.2 (MPa)	707
Tensile strength Rm (MPa)	892
Flexural strength A5 (%)	7.8
Vickers hardness HV 10	336
Modulus of elasticity E (GPa)	219
Laminating strength (ISO 9693) with Carmen®-Verblendkeramik (sold by Esprident GmbH)	49.18 MPa